

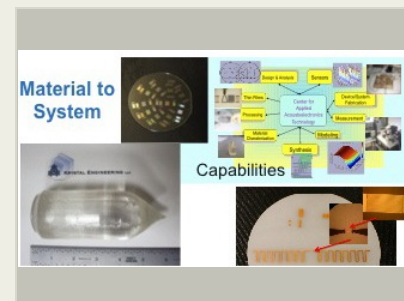
# New Wireless Sensors for Diagnostics Under Harsh Environments, Phase II

Completed Technology Project (2012 - 2015)



## Project Introduction

High-temperature passive wireless surface acoustic wave (SAW) sensors are highly desirable for improving safety and efficiency in aviation and space vehicles. This proposal addresses the growth and processing of a new class of high temperature material into acceptable SAW wafers, the production of SAW temperature sensors, and the integration of the SAW and thin film antenna (SAWtenna). The project will provide a new, unique material grown in the US (no other US manufacturer is known, produce high temperature, radiation hard, solid state, passive wireless sensors for use in harsh environments. In this project, we will: 1) Develop a crystal material for SAW wafers suitable for high-temperature SAW fabrication. 2) Design orthogonally frequency coded OFC (up to 1000 degrees C) SAW temperature sensors . 3) Integrate the SAW and antenna onto the wafer such that there are no external connections. In Phase I the capability for the production of LGT crystals was established and 2in diameter boules were grown. The crystals were processed into SAW wafers and confirmed to be of excellent quality, as evidenced from SAW parameters extraction. A thin film process using simple metallization demonstrated extended device operation at 700 oC and short-term operation at 800 oC. Phase I demonstrated the feasibility of high-temperature SAW devices, and a clear path in the Phase II effort for 1000 oC device operation. During Phase II, we will explore variations of the metallization and encapsulation, which will extend device life. SAW OFC high temperature sensors, operating in the 915 ISM band, will operate simultaneously over temperature and will be delivered to NASA. Phase II will develop a fully integrated sensor antenna and upscale the crystal growth for 3-4in SAW wafers. Probability for Phase III commercialization of both the wireless SAW sensors and SAW wafers is very high.



New Wireless Sensors for  
Diagnostics Under Harsh  
Environments Project Image

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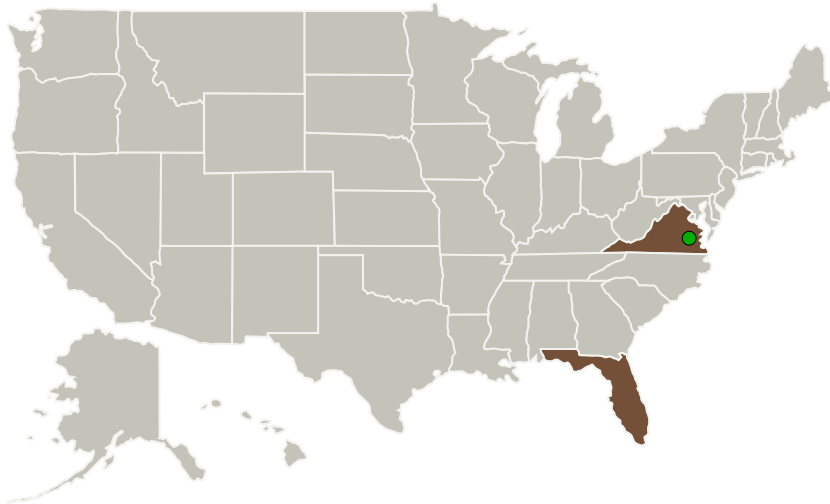
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Krystal Engineering LLC	Lead Organization	Industry	Titusville, Florida
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

## Primary U.S. Work Locations

Florida	Virginia
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## Project Transitions

▶ **September 2012:** Project Start

✓ **April 2015:** Closed out

## Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/137409>)

## Organizational Responsibility

## Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

## Lead Organization:

Krystal Engineering LLC

## Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

## Program Director:

Jason L Kessler

## Program Manager:

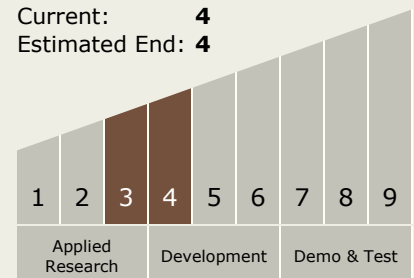
Carlos Torrez

## Principal Investigator:

William P Hanson

## Technology Maturity (TRL)

Start: **3**  
Current: **4**  
Estimated End: **4**

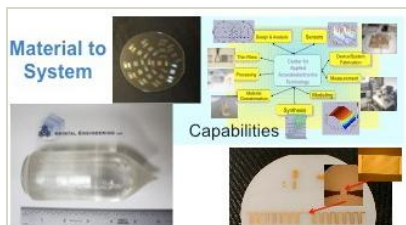


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## Images



### Project Image

New Wireless Sensors for  
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(<https://techport.nasa.gov/image/135518>)

## Technology Areas

### Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - └ TX12.3 Mechanical Systems
    - └ TX12.3.4 Reliability, Life Assessment, and Health Monitoring

## Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System